

VII. FURTHER OBSERVATIONS ON *RANA TIGRINA*.

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I. REMARKS ON *RANA TIGRINA* AND ITS VARIETIES.

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Needless to say, I have been keenly interested in reading Dr. Annandale's attempt to solve the problem of the species, the races or varieties I should call them, that have been grouped together under the name of *Rana tigrina*.¹

I cannot help thinking that with a more extensive material, Dr. Annandale would have reached somewhat different conclusions, and the object of these notes is to show on what points his definitions require emendation. I will first discuss the various 'species' under the names assigned to them by him, and in the same order, and then wind up with my own definition of *R. tigrina* and of the varieties into which it may be divided.

Rana tigrina, Daud.

There can be no doubt as to the application of this name in the restricted sense, and on this point we are in agreement. But I am surprised not to find any allusion to the two forms, strikingly different in their extremes, which are found in India and Ceylon. Dr. Annandale tells us that the inner metatarsal tubercle varies greatly in size and shape, a variation which, according to him, seems to be individual rather than racial, but he appears to me to be mistaken when he adds that this variation is not correlated with other differences and that it occurs at many or all points in the geographical range of the species. The two forms which I think should be distinguished are:—

(1) The typical *R. tigrina*, with smaller and blunter inner metatarsal tubercle ($1\frac{2}{3}$ to 3 times in length of inner toe, $7\frac{1}{2}$ to $12\frac{1}{2}$ times in length of tibia), 'habit rather slender than stout, but moderate rather than extreme in either direction,' and 'the tibia about half as long as head and body.'

(2) The much stouter, often more toad-like *R. crassa*, Jerdon (*fodiens*, Peters *nec* Jerdon, *ceylanica*, Peters) with very large, shovel-shaped inner metatarsal tubercle (1 to $1\frac{1}{2}$ times in length of inner toe, 5 to 7 times in length of tibia), and the tibia $2\frac{1}{7}$ to $2\frac{1}{2}$ times in length of head and body. Further, when the hind limbs are folded at right angles to the body, the heels overlap in the former but do not in the latter; the tibio-tarsal articulation reaches the eye or between the eye and the nostril in the former, the tympanum or the eye in the latter.

¹ *Mem. As. Soc. Bengal*, VI, p. 121 (1917).

The differences between these two forms are quite as great as between the typical *R. esculenta* and the var. *lessonae*, and, to judge from the rather scanty material at my disposal, there is not the same overlap.

As regards the distribution, although both forms appear to occur together in some localities (Benares, Malabar, Ceylon), it does not seem to be so generally, and I was assured some years ago by Dr. Henderson that the var. *crassa* is the only one found near Madras town, where its fossorial habits distinguish it so sharply from the true *R. tigrina* as to have raised doubts in his mind as to the propriety of uniting both under the same specific name.

From the following table of measurements it will be seen that the width of the head may considerably exceed its length in both the typical form and the variety. It has been stated that "when the foot is stretched out the margin of the web is slightly convex¹ between the fourth and fifth toes." If *R. crassa* is to be included in *R. tigrina*, this statement requires modification, as Peters in his description of *Hoplobatrachus ceylanicus* ascribes to it a rather deeply emarginate web, as is confirmed by a few of the specimens in the British Museum.

I have another correction to make to Dr. Annandale's definition of *R. tigrina*. The granular nature of the skin in some specimens may extend to the back of the head, as far as the eyes (Benares, Ceylon). Narrow, interrupted, but well defined glandular folds, 6 to 14 in number, are nearly always present on the back, and their number and regularity constitute a fairly good though not absolutely constant character for distinguishing the typical form and the var. *crassa* from the other varieties.

Some specimen of the var. *crassa* (Benares, Malabar) have large black spots on the gular region.

There is often a narrow light vertebral streak or fine line, which may be accompanied by another along the calf, as in the type figured by Daudin; a broad vertebral band, as in the var. *cancrivora*, I have never seen.

Rana rugulosa, Annand. nec Wiegman.

Wiegmann's figures of *R. rugulosa* and *R. vittigera* are excellent and may be relied upon. They demonstrate that these two supposed species, founded on the coloration, are identical, even in a racial sense, and as both show a decidedly pointed snout, the tibia half the length of head and body, and the web between the toes strongly emarginate and not reaching beyond the penultimate phalanx, they answer the definition of *R. cancrivora* and not that of Annandale's *R. rugulosa*.

The name *R. burkilli*, Annand., should therefore be revived for the form, from Burma, Siam, and China, which differs from *R. tigrina*, s. str., in the generally shorter hind limb, the length of the tibia being contained $2\frac{1}{5}$ to $2\frac{1}{2}$ times in that of head and body, the heels not or but slightly overlapping, and the tibio-tarsal articulation reaching the shoulder, the tympanum, or the posterior border of the eye. The fourth

¹ No doubt a lapsus for 'concave'.

Measurements in millimetres.

R. tigrina, typical.

var. *crisiger*.

	<i>R. tigrina</i> , typical.												var. <i>crisiger</i> .							
	Lahore.		Sikkim.	Nepal.		Benares.	Madras.	Malabar.	Ceylon.		Penang(?)*	Benares.	Madras.	Malabar.	Ceylon.					
	♂	♀	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
From snout to vent	120	108	108	77	86	112	162	70	65	88	80	158	114	82	90	89	76	76	112	102
Head	38	36	36	26	29	46	51	24	22	30	29	50	38	28	31	29	23	26	36	33
Width of head	40	41	43	26	29	55	62	25	23	32	29	61	40	30	36	32	26	27	40	39
Snout	17	16	16	10	12	20	21	9	9	11	12	21	16	10	12	11	9	10	14	15
Eye	11	11	10	8	9	12	15	8	8	10	9	14	10	8	11	9	9	9	11	11
Interorbital width	4	4	4	3	3	5	6	3	3	3	3	6	4	4	3	3	2.5	2	4	4
Tympanum	8	9	9	6	6	11	11	6	5	6	6	11	8	6	6	6	5	5	8	8
Toes limb	54	57	53	37	40	75	80	37	33	47	41	72	53	39	49	42	36	39	57	60
1st finger	9	11	11	7	8	15	15	7	7	9	7	16	11	8	9	8	7	7	10	11
2nd "	7	9	9	6	6	12	12	5	5	7	6	12	8	6.5	7	6	5	5	8	8
3rd "	10	14	12	8	9	15	15	7	7	10	8	16	11	8	10	9	7	7	10	11
4th "	6	7	9	5	6	12	11	5	5	7	6	11	9	6.5	7	6	5	5	8	8
Hand limb	156	170	167	117	130	202	222	100	97	125	116	225	174	100	139	118	98	106	155	161
Tibia	51	54	58	38	43	71	74	31	30	43	38	75	60	35	42	35	31	32	48	48
Foot	50	52	55	36	42	67	68	32	30	45	38	71	55	38	44	41	32	32	50	50
3rd toe	27	27	27	17	20	33	33	15	15	22	17	34	27	15	23	21	13	16	27	27
4th "	39	43	41	28	33	50	49	24	24	32	29	54	43	25	34	31	24	25	38	40
5th "	27	28	27	18	23	35	35	17	17	25	19	55	48	17	26	23	16	17	29	29
1st "	12	13	13	9	10	17	17	7	7	9	8	17	14	7	9	7	6	7	9	10
Inner metat. tubercle	5	5	7	3	4.5	9	9	4	4	5	4	9	6	7	6	6	6	6	7	7

* This locality is doubtful, as in the case of other specimens, probably from India, described by Cantor as found in the Malay Peninsula.

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toe is usually, but not constantly, shorter; sometimes the third toe reaches the distal subarticular tubercle of the fourth, sometimes it does not; there is no constant difference in the degree or emargination of the web, the large specimen from Toungoo, of which measurements are given in the following table, having the web as full and as feebly notched as in any Indian specimen I have seen. The inner metatarsal tubercle is blunt and its length is $2\frac{1}{2}$ to 4 times in that of the inner toe and $8\frac{3}{4}$ to 14 times in that of the tibia.

Although usually more rounded than in the typical form, the shape of the snout cannot be used for the distinction of this variety since it is more pointed and prominent in some specimens from China (Shanghai) than in others from India (Madras).

The folds on the back, if present, are short and in many cases they are more correctly described as elongate warts.

The absence of any trace of a light streak above the upper lip, which is marked with vertical dark bars, one or two of which may extend to the eye, distinguishes this form, but the presence of black spots or marblings on the lower parts is not constant; a specimen from Pegu is without any spots on the throat and belly, and others from Thayetmyo, Ayuthei, and Shanghai have the markings reduced to a streak in the middle of the throat. A light vertebral streak or band is absent in all the specimens examined by me.

The size often exceeds 110 millimetres from snout to vent (Toungoo, Siam, Shanghai).

Measurements in millimetres.

	var. <i>burkilli</i> .															
	Toungoo.		Thayetmyo.	Mandalay.	Pegu.	Takhana, Siam.		Siam.		Ningpo.		Shanghai.		Formosa.		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
From snout to vent	142	60	57	127	93	130	133	85	95	90	117	92	91	90	89	
Head	47	20	19	39	30	41	44	28	32	27	37	28	28	29	29	
Width of head	53	21	21	44	32	43	53	32	34	30	43	32	31	33	31	
Snout	20	9	8	16	12	16	16	12	12	12	15	11	12	12	11	
Eye	13	7	6	11	10	12	12	8	8	8	10	9	9	9	9	
Interorbital width	5	2.5	2.5	4	3	5	5	4	4	4	5	3	3	3	3	
Tympanum	10	4	4	9	6	8	8	7	7	7	7	7	7	7	7	
Fore limb	73	29	27	65	48	63	70	45	49	50	58	48	45	46	46	
1st finger	15	6	6	13	9	12	13	10	9	11	12	9	9	9	10	
2nd "	13	5	5	10	8	10	10	8	8	9	10	7	7	8	8	
3rd "	15	7	6	14	10	14	14	10	10	11	13	10	10	10	10	
4th "	12	4	4	10	7	9	10	7	8	9	9	7	7	7	7	
Hind limb	180	80	72	159	128	178	192	120	140	138	160	116	123	125	125	
Tibia	58	26	24	52	40	57	62	38	39	40	47	38	37	39	38	
Foot	62	26	24	54	44	59	64	42	43	47	54	42	43	42	42	
3rd toe	31	15	13	27	22	28	35	23	25	26	28	21	22	23	23	
4th "	60	21	18	42	35	46	54	34	35	39	43	32	34	34	34	
5th "	35	16	13	30	26	33	38	24	26	28	30	23	24	24	25	
1st "	17	7	6	14	11	15	16	12	12	13	14	11	11	10	11	
Inner metat. tubercle	6	3	2	6	3	4	6	3	3	4	5	4	3	4	4	

This form is hardly to be distinguished from the African *R. occipitalis*, Gthr., the range of which extends from the Egyptian Soudan and Uganda to the Senegal and other parts of West Africa as far south as Angola. I am not sure I could always tell a Burmese frog from an African, and the tadpoles are identical. Although I have examined over forty specimens of *R. occipitalis*, I have never seen one with a light vertebral streak. It reaches a length of 130 millimetre from snout to vent.

Rana cancrivora, Gravenh.

I have a large material from the Indo-Malay Archipelago which shows that although the toes vary considerably in length, the web between them is always strongly emarginate; in some specimens even the two last phalanges of the fourth toe are free from the web, and such may be described as having the toes three-fourths webbed. The length of the tibia is $1\frac{3}{4}$ to $2\frac{1}{4}$ times in the length of head and body, the heels strongly overlap, and the tibio-tarsal articulation reaches the eye or between the eye and the nostril; the longer hind limb thus distinguishes the var. *cancrivora* from the var. *burkilli*. The inner metatarsal tubercle is blunt and its length is contained $2\frac{1}{2}$ to 3 times in that of the inner toe, $8\frac{1}{2}$ to 12 times in that of the tibia.

The shape of the head varies greatly; it is often quite as long as broad, and it may even be slightly longer (Padas, N. Borneo); the snout may be broadly rounded or as pointed as in any specimen of *R. tigrina typica*; when the snout is pointed, the nostril is as a rule equidistant from the eye and the tip of the snout.

The distance between the eye and the tympanum measures $\frac{1}{2}$ to $\frac{3}{4}$ the diameter of the latter ($\frac{2}{5}$ to $\frac{2}{3}$ in the typical form).

The vomerine teeth vary considerably and often differ from those of the typical form in being disposed in rather short oblique series, well separated from the anterior borders of the choanae; but some specimens (Borneo, Java, Celebes) have longer and stronger series, which agree entirely with the usual description.

The longitudinal dermal folds, in the strict sense, are often absent on the body; if present, they are reduced to 2 or 3 pairs.

The coloration is much as in the var. *burkilli*, but there may be, rather exceptionally, a light streak along the side of the body, as in the typical form (specimens from the Philippines and Celebes); a light vertebral line or broad band is sometimes also present, but it is very rarely accompanied by a light line along the calf (specimens from the Philippines). This is a small form, not exceeding the length of 90 millimetres from snout to vent assigned to it by Dr. Annandale.

I will now give a definition of *Rana tigrina* and of the forms into which it may be divided.

***Rana tigrina*, Daud.**

Vomerine teeth in strong or very strong oblique, straight or slightly curved series narrowly separated from each other, originating close to or at a short distance from the anterior border of the choanae and usually extending beyond the level of their posterior borders. Head as long as

Measurements in millimetres.

var. *anteriora*.

	Danduj, Jalor.		Kodali.		Dell, Sumatra.		Java.			Sumbawa.		Sumba.		Onbay.		Timor.		Borneo.				Padang, N. Borneo.			Philippines.		Sutirano, Philippines.		Laguina del Bay, Philippines.		Mandy, Celebes.		Kema, Celebes.	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29					
From snout to vent.	49	52	60	88	77	88	75	65	56	49	59	57	57	73	98	81	78	86	59	54	57	57	66	61	75	72	72	86	86					
Head	15	27	25	28	26	29	26	22	20	22	21	20	21	23	29	27	27	29	20	19	18	19	19	26	24	24	21	21	24	25				
Width of head	18	30	21	32	27	30	27	22	20	22	21	22	22	27	31	27	27	29	19	21	18	20	23	12	16	26	25	25	26	25				
Snout	7	11	8	11	11	12	11	9	7	9	8	7	7	9	11	11	11	12	8	7	6	8	9	8	10	10	9	9	10	10				
Eye	6	8	7.5	8	8	8	8	8	7	8	8	7	7	8	8	8	8	8	7	7	7	8	7	7	8	8	8	8	8	8				
Interorbital width.	1	3.5	3	4	3	3	3	3	2.5	3	2.5	2	2	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	3	3	3				
Tympanum	3.5	6	4	6	6	6	6	4	4	4	4	4	4	4.5	6	6	7	6	4	4	4	4	5	5	6	6	5	6	6	6	6			
Fore limb	30	46	36	47	40	47	42	32	31	35	32	33	34	39	47	45	43	47	36	34	34	34	37	32	42	39	36	45	45	45	45			
1st finger	6	9	7	9	10	11	10	7	6	7	7	7	7	8	9	10	10	10	7	7	7	7	7	7	7	8	9	10	10	10	10	10		
2nd "	3	8	6	8	7	8	8	6	5	6	6	6	6	7	6	8	7	7	5	5	5	5	5	5	5	6	7	8	8	8	8			
3rd "	7	10	8	10	10	11	10	7	6.5	7	7	7	7	8	9	10	10	10	7	7	7	7	7	7	7	8	9	9	9	9	9			
4th "	4	6	5.5	7	6	8	7	5	5	6	6	5	5	6	6	8	7	7	5	5	5	5	5	5	5	6	7	8	7	7	7			
Hand limb	74	119	86	131	115	132	112	93	82	102	87	95	92	108	127	129	121	140	90	87	88	93	111	95	107	103	105	122	110	122	110			
Tibia	23	38	32	42	37	42	36	29	26	33	29	30	30	35	41	39	38	43	28	27	28	29	36	31	34	32	35	35	37	35	35			
Foot	25	41	37	45	40	45	39	29	26	35	30	31	30	36	43	43	43	47	30	29	30	33	36	31	34	32	35	35	35	35	35			
3rd toe	14	20	17	22	19	23	20	14	13	17	14	15	15	18	21	20	20	23	15	14	15	15	17	17	17	17	17	17	19	20	20			
4th "	19	33	25	37	32	37	31	23	19	27	24	24	25	26	36	36	38	38	22	22	22	25	29	26	30	29	29	30	33	33	33			
5th "	14	23	18	27	22	27	21	16	14	19	17	16	17	18	24	24	24	25	16	16	17	18	18	18	18	20	20	20	22	23	23			
1st metat. tubercle.	6	10	8	11	9	11	10	7	6	8	7	7	7	9	9	11	10	12	7	7	7	6	9	7	9	9	9	9	10	10	10	10		
2nd "	2	4	3	4	4	4	4	3	2.5	3	2.5	3	2.5	3	4	4	4	4	2.5	3	3	3	3.5	3	4	3.5	3	3	3	3	3	3		

broad or broader than long, rarely slightly longer than broad; snout rounded or pointed, projecting more or less beyond the mouth, longer than the eye in the adult; canthus rostralis obtuse; loreal region very oblique, more or less concave; nostril equidistant from the eye and the tip of the snout or nearer the latter; interorbital space much narrower than the upper eyelid; tympanum very distinct, $\frac{1}{2}$ to once the diameter of the eye, its distance from the latter $\frac{2}{5}$ to $\frac{3}{4}$ its diameter. Fingers obtusely pointed, first longer than second; subarticular tubercles rather small and feebly prominent. Hind limb variable in length, but tibio-tarsal articulation never reaching the tip of the snout; heels meeting or overlapping when the limbs are folded at right angles to the body; tibia $1\frac{3}{4}$ to $2\frac{1}{2}$ times in length from snout to vent, as long as, or shorter than the foot, usually shorter than the fore limb. Toes obtuse or somewhat swollen at the end, at least $\frac{3}{4}$ webbed, often webbed to the tips; subarticular tubercles rather small; a more or less developed dermal fold on the outer side of the fifth toe and usually a feeble one on the inner side of the first and of the tarsus, interrupted by the inner metatarsal tubercle, which may be small and blunt or large and sharp-edged; no outer metatarsal tubercle. Upper parts rarely nearly smooth, usually with large, more or less prominent warts forming longitudinal series on the back, or with more or less regular longitudinal glandular folds; usually a strong fold across the head, behind the eyes continued as a curved glandular fold from the eye to above the shoulder; lower parts smooth.

Male with a white or grey external vocal sac on each side of the throat, forming longitudinal folds; fore limb moderately thickened; a strong pad on the inner side of the first finger, covered, during the breeding season, with a greyish-brown velvet-like horny layer.

Nasal bones large, in contact with each other and with the frontoparietals; ethmoid hidden or only a small portion uncovered; frontoparietals narrow, feebly grooved along the median line, sometimes fused; zygomatic process of squamosal long. Coracoids more or less distinctly overlapping with their proximal extremities; clavicles strong and horizontal; omosternum and sternum with a moderately long bony style, the former forked at the base. Terminal phalanges obtusely pointed.

Tadpole with the tail attenuate to a fine point, about twice as long as the body. Circular lip entirely bordered with papillae; back entirely black, the upper mandible with a strong median cusp, the lower with two; horny teeth in 3 or 4 upper and 4 or 5 lower series, the outer upper long and uninterrupted, the outer lower short and uninterrupted, the outer but one lower long and uninterrupted.

A. Regular glandular folds, 6 to 14 in number, usually present on the back; toes webbed to the tips.

Tibio-tarsal articulation reaching the eye or between the eye and the nostril; heels overlapping; tibia $1\frac{9}{10}$ to $2\frac{1}{5}$ times in length of head and body; metatarsal tubercle $\frac{1}{3}$ to $\frac{2}{3}$ length of inner toe . . . *Forma typica*

Tibio-tarsal articulation reaching the tympanum or the eye; heels not overlapping; tibia $2\frac{1}{4}$ to $2\frac{1}{3}$ times in length of head and body; metatarsal tubercle $\frac{2}{3}$ to once length of inner toe var. *crassa*, Jerd.

- B. Glandular folds much broken up or absent; if long, fewer in number; inner metatarsal tubercle $\frac{1}{4}$ to $\frac{2}{5}$ length of inner toe.
- a. Toes webbed to the tips or at least to the base of the last phalanx of the fourth; tibia $2\frac{1}{3}$ to $2\frac{1}{2}$ times in length of head and body; heels not or but slightly overlapping.
- Tibio-tarsal articulation reaching the eye or between the eye and the nostril var. *occipitalis*, Gthr.
- Tibio-tarsal articulation reaching the shoulder, the tympanum, or the posterior border of the eye . . . var. *burkilli*, Annand.
- b. Toes incompletely webbed, one or two phalanges of fourth free; tibia $1\frac{3}{4}$ to $2\frac{1}{4}$ times in length of head and body; heels strongly overlapping; tibio-tarsal articulation reaching the eye or between the eye and the nostril var. *cancrivora*, Gravh.

In uniting these different forms under one species, I am simply adhering to the standard adopted in the case of *R. esculenta*, in which we find the same amount of variation in the shape of the head, in the proportions of the hind limb, in the development of the inner metatarsal tubercle and, nearly though not quite, in the extent of the web between the toes; and as I have not the slightest doubt as to the justification of the course followed in dealing with that highly variable and widely distributed species, of which I have carefully studied a very large material, I feel satisfied that the conclusion adopted in the analogous case of *R. tigrina* serves best the purposes of exact systematics. It has always been my firm conviction that the multiplication of specific names on differences which break down when put to the test of a large material is not conducive to an advance in our knowledge, whilst the recognition of forms to which subordinate rank is assigned fulfils all requirements and leads to a truer appreciation of the state of things in Nature.

It is, however, with diffidence and provisionally that I include *R. cancrivora* among the varieties of *R. tigrina*.

I have not seen examples of van Kampen's *R. angustopalmata*, from Macassar, but if its tadpole is practically identical with that of *R. limnocharis*, as he states, may it not be a distinct species? As to the tadpoles described from Java, is a confusion with *R. limnocharis* absolutely out of question? Dr. van Kampen himself, when alluding to Flower's identification of Siamese tadpoles, regarded it as almost incredible that the Malay frog, so difficult to distinguish from the Burmo-Siamese, should differ to that extent in the larval condition. I therefore believe the question of the specific rank of *R. cancrivora* should remain open until Dr. van Kampen adduces further proof of the correctness of his identification of the Javan tadpoles.

I hope I may be pardoned for raising these doubts, in view of the fact that, even in so geographically remote a form as *R. occipitalis*, the very striking buccal characters of the tadpole of *R. tigrina* have remained unchanged.

If, however, it should be established beyond doubt that *R. cancrivora* passes through a larval stage so different from that of *R. tigrina*, I would then unhesitatingly endorse Dr. Amandale's conclusion as to the specific distinction.